

# Salt Runoff Collection System

## FINAL REPORT November 2008

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New Jersey  
Department of Transportation  
Division of Research and Technology  
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U. S. Department of Transportation  
Federal Highway Administration

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## **ACKNOWLEDGEMENTS**

The authors wish to thank Robert Lane, Ed Kaus and Ed Kondrath of the NJDOT and Jeanette Mar of the FHWA without whom this study could not have been done.

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## **INTRODUCTION**

The original research plan, in response to the RFP, is set forth in the following sections. The research plan was designed to develop a program to bring the NJDOT in compliance with the new stormwater regulations of the NJDEP. A meeting was held with NJDEP staff in the Stormwater Bureau shortly after the contract was awarded. At that meeting, DEP personnel informed us and DOT staff that any discharge off of DOT sites would require an “individual permit” from the DEP. It was apparent to all at the meeting that the path to be taken for compliance would best be served by not allowing discharge off any of the DOT sites.

This caused the project team and the DOT to change the focus of the research project. In the sections that follow, the original and the modified research plans are delineated.

## **ORIGINAL RESEARCH PROBLEM AND BACKGROUND**

The New Jersey Department of Transportation has 84 maintenance yards at different locations in New Jersey (see Figure 1 – NJDOT Facilities). These yards are facing the threats of uncontrolled runoff from the yards to the surrounding environment. The Bureau of Facilities, Planning and Engineering and Construction is concerned about salt runoff from their equipment and garage facilities. The Department has identified typical environmental degradation issues relative to their maintenance yards. These are; **salt spillage during unloading and loading trucks, and truck/equipment washing.**

It is required to **identify methods to prevent runoff, control/treat runoff, and state-of-practice for cleaning/washing vehicles/equipment** that can be best accomplished at yards where no sanitary service is available with possible temporarily as well as permanent systems.

The proposed factors and issues will be considered in future design and construction of new maintenance yards.

## **ORIGINAL RESEARCH OBJECTIVES**

The objectives of this study as set forth in the RFP are to:

1. Prioritize DOT’s yard facilities based on geographic area and receiving water sensitivity
2. Develop methods to prevent runoff, control/treat runoff and truck/equipment washing facilities at the existing maintenance yards without endangering the environment
3. Determine state-of -practice for design and construction of new maintenance yards in the future in terms of controlling salt runoff.

## **ORIGINAL RESEARCH PLAN**

### **Introduction**

The focus of the research is to minimize the salt lost to the environment at the NJDOT’s 84 storage facilities. Where salt is lost, determine if it represents a threat to the

environment. In those cases where there is a real concern, develop cost effective strategies that will alleviate or mitigate those effects.

The team will visit approximately 6 to 10 individual facilities that will be identified by NJDOT staff as representative of all of the 84 facilities. These visits will be made by at least two team members. A site data sheet will be completed for all 84 facilities with the cooperation of the Department. The team recognizes that it is difficult to prioritize all 84 facilities without having seen all of them. Based upon the site recons and the data sheets, a priority list of sites with potential risks will be developed. After the initial visits and the data for the site evaluation sheets have been gathered, the team will perform additional site visits to any facility not already visited if the data suggests that they have a high priority for retrofit (to a maximum of ten more sites). If additional visits are deemed necessary, a separate proposal will be submitted.

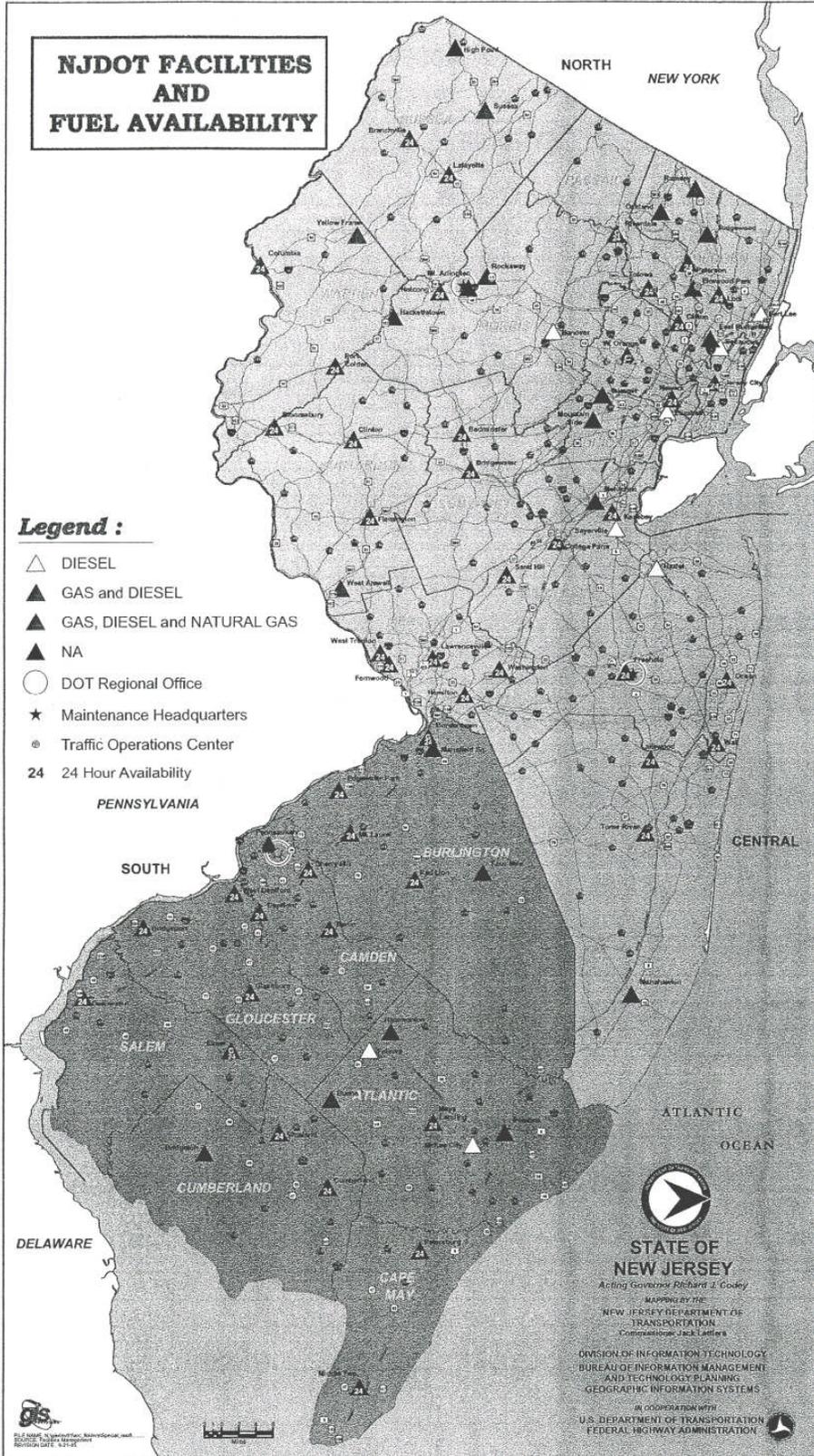


Figure 1 – NJDOT Facilities Map

The proposed research will investigate methods to control the impact of salt runoff to the environment. The search will accomplish the following initiatives:

- Perform a detailed search of current state-of-the-art practices in the control of salt runoff. These will include Best Management Practices (BMPs) as well as design practices of storage facilities and related equipment.
- Develop a database of environmental issues associated with salt runoff from salt storage facilities.
- Develop a database of the 84 facilities, through site visits and information provided by the NJDOT and published data, with regard to their design, service area, environmental sensitivity of the receiving waters, operating practices, and other issues as detailed in this proposal.
- Compile a compendium of all available designs and operating practices and equipment for the operation of salt storage facilities.
- Develop a prioritized list of the current facilities according to the potential environmental impact of their salt runoff.
- Based upon the compendium of methodologies selected, develop, for selected sites requiring remediation, which solutions would work in the most cost effective way that also fits within the constraints of the facility.
- Develop a manual that could be utilized by NJDOT personnel to analyze and remediate other facilities.
- The manual would also be used to provide design guidance for new facilities. Siting issues will also be developed as part of the manual to aid in the design and location of new facilities.

There is an extensive body of information on BMPs and design of salt storage facilities. The initial search by the project team has yielded excellent information in this area. The information is not site specific. This research will focus on the application of this knowledge base to the specific facilities in New Jersey, both current and future.

The team will enhance this knowledge base in the specific area of what to do with the runoff that leaves the site and when it is a problem that must be addressed.

### **Original Tasks to Accomplish the Project**

#### **Phase 1. Literature Search**

*Conduct a literature search of the current state of the practice. After the award of the project, a more comprehensive literature search should be conducted. At the completion of this literature search, the PI will make a presentation to the Research Project*

*Selection and Implementation Panel to discuss their findings and to discuss the appropriate research approach.*

**Phase II – Research Approach (Tasks & Deliverables)**

Task 1: Review state-of-practice in other states and countries that have employed in responding to the problem and the impacts thereof.

Task 2: Analyze factors or criteria to address typical environmental issues separately. These issues are not restricted to those identified by the Department.

Task 3a: Prioritize DOT’s yard facilities based on receiving water sensitivity and potential impacts

Task 3b: Propose innovative technologies for salt containment at existing yards, including their benefit/cost estimates, effectiveness, and space requirement.

Task 4. Provide recommendations for the state-of-practice for future design and construction for new yards and retrofit current facilities as prioritized.

Task 5: Develop economic methods, procedure, and equipment required for each design. List the pros/cons and an estimated cost to implement.

**IMPLICATIONS OF DISCUSSIONS WITH THE NJDEP ON THE RESEARCH PLAN**

The initial meeting with the NJDEP caused the NJDOT and NJIT project teams to revise the original research approach for the project. This is delineated in the minutes of the DEP/DOT/NJIT meeting as follows.

**Minutes of Meeting with NJDEP - Feb. 7, 2005 - DOT Salt Project**

**Attendees**      *Ms. Connie House (DOT) – Bob Lane’s Group  
Matthew Klewin (NJDEP)  
Bruce Friedman (NJDEP)  
Bob Dresnack & Gene Golub (NJIT)*

**Comments by Connie House (DOT) prior to meeting with NJDEP**

- *26 maintenance yards have drinking water wells*
- *3 years of data at these sites*
- *Not enough employees at site to warrant permitting by NJDEP*
- *Only problem sites where DEP is involved are  
Port Colden  
Washington Township (Hightstown – Rte 130N) – also monitoring adjacent nursery (plants affected); monitoring for Total Petroleum*

*Hydrocarbons, sodium chloride and C.O.D. Finally stopped salting operation at this location.*

**Comments during meeting with NJDEP**

- *Burlington County is coordinating with municipalities to share costs of truck washing facilities*
- *For DOT maintenance yards, Best Management Practices “housekeeping” – e.g. pollution prevention, source control is where we are to be – there are no applicable rules for treatment; also no new regulations apply on vehicle washing – just concerns related to site discharges*
- *NJDOT systems are considered the same as municipalities*
- *NJDEP permits are not required for each site; rather the three DOT maintenance yard regions (north, central and south) are permitted.*

***NJDEP provided us with two documents***

***1. “New Jersey Pollutant Discharge Elimination System for Highway Agency Stormwater Master General Permits”***

*The key sections cited therein by NJDEP are:*

- *Page 16 – entitled Maintenance Yard Operations*
- *Attachment D, p. 29 – Vehicle Maintenance*
- *P. 2, item ix. – related to rinsing of equipment*
- *P. 12 related to Illicit Connection Elimination*

***2. “Highway Agency Stormwater General permits Part 1 – Narrative Requirements”***

- *Specific reference made to p. 17 entitled “Equipment and Vehicle Washing”*

*We were also provided with a disk entitled “Highway Agency – Municipal Stormwater Guidance”*

*Copies of the above will be duplicated for all team members.*

*NJDEP also cited, for general reference, NJAC 7:14A-25, the stormwater regulations originally adopted from the USEPA which describes who is regulated, permit contents, and the “6 minimum measures” in developing a pollution prevention plan.*

- *The effective starting date of NJDEP’s program is 4/1/04; the plan will be revisited in 5 years.*
- *NJDEP believes main sources of salt pollution occur during loading of salt into storage areas and brushing the excess salt from the trucks during the loading operations.*
- *Confirmation by NJDEP that one can rinse trucks, but with only clean water*
- *Bruce Friedman said that unless one eliminates discharge from each site, one gets into a costly and time consuming permitting process.*

*The more pragmatic approach appears to be elimination of floor drains and use of holding tanks to collect and store site drainage. Same stored volumes can be arranged through contractors to haul away periodically as hazardous wastes.*

- *NJDEP said that it is acceptable to have minimal amounts of salt run off the site without the need for monitoring as long as B.M.P's are instituted.*
- *In some cases, NJDEP suggested that DOT may wish to retrofit sites with some BMPs (e.g., grassed swales)*
- *NJDEP intends to inspect each site once a year from 4/1/04; and the salt structures 3 years from 4/1/04.*
- *Educating personnel at each site is important, but also recognized by NJDEP as difficult to enforce.*
- *Regarding the vast ranges in site in terms of state-of-the-art infrastructure, Hammonton on Route 30 is excellent, and in Salem County (Bridgeton) – on Route 295 is poor.*
- *Loan grants through NJDEP with 80/20 matching may be available to NJDOT at interest rates of 1/2 the prime rate.*

## **REVISION OF THE RESEARCH PLAN**

### **Introduction**

As a result of the above meeting with the NJDEP, NJIT presented the need for changing the scope of research to the Department at the Quarterly Meeting in April 2005. Both parties agreed to modify the research effort. The revisions to the research plan were implemented to meet the criteria of the NJDEP. These include the following:

Expanded the number of site visitations from the original “6 to 10” to all 84 salt yards. A salt containment program is performed on a site level and therefore all of the sites needed review. A database for the 84 sites would be developed including site characteristics, environmental factors, utility availability, drainage patterns, general site conditions, salt storage facilities, etc...

Develop a truck washing program for the NJDOT in coordination with the three regional directors. The program would include all 84 sites. The estimated cost and potential phasing of the program would be included in the study.

The truck washing program would include evaluation of current manufacturers of self-contained facilities. The project team would visit and evaluate truck washing facilities in the region and obtain detailed information from the manufacturers such as siting requirements, cost for purchase and lease operation, etc... The team would also investigate the use of basic (low-tech) facilities at each individual site.

NJDOT personnel made us aware of four salt facilities that had experienced problems with salt migration onto neighboring sites. The NJIT team would investigate the four situations and make recommendations to avoid similar problems in the future.

## **IMPLEMENTATION OF THE REVISED RESEARCH PLAN**

### **Introduction**

The revised research plan included a literature search at the outset. The intent was to familiarize the project team with current structural and non-structural Best Management Practices (BMPs) prior to visiting the 84 maintenance yards. The search findings and related references reviewed follow.

## **LITERATURE SEARCH - SALT RUNOFF COLLECTION SYSTEMS**

### **Introduction**

Storm run-off containing road salts used in deicing operations have become a source of contamination of surface and sub-surface water bodies and water ways which provide clean water for human consumption. In certain localities high concentrations of ions have been found in plants and animals and have been linked to storm runoff containing road salts (USEPA, 2002). Salt is found to be the most viable de-icing material which keeps roads, highways and pedestrian paths open during winter weather; its use accounted for \$289.5 Million in costs in 1998 (USGS, 2002). However, the impact of salt runoff on the environment, and high corrosion rates on highway structures and vehicles have been identified as major issues of concern.

The proposed Phase II rules of the United States Environmental Protection Agency (USEPA), governed by the Clean Water Act [Section 402(p), December, 1999] regulates pollutants entering waterways from publicly owned and operated storm water systems. Many state departments of environmental protection (DEP's) have taken steps to develop municipal storm-water management programs (MSRP) to seek compliance with the proposed regulations.

The adverse environmental implications arising from improper use of salt and the proposed regulatory requirements have made many state departments of transportation (DOT's) to take a proactive approach towards controlling storm water runoff containing salt. Many local government agencies are reviewing the techniques and material use at their local maintenance facilities to adopt favorable management practices and techniques that minimizes salt use and hence salt runoff. The literature highlights the use of salt-brine for pre-wetting of deicing salts, anti-icing, and the use of Road Weather Information Systems (RWIS) in winter road maintenance.

Many road maintenance facilities with salt and sand storage have been recognized as point sources discharging untreated salt runoff to the environment. Road maintenance facilities become a major polluter if located in an environmentally sensitive area. The National Pollutant Discharge Elimination System (NPDES, 2000) requires unprotected salt storage facilities and those discharging untreated runoff to obtain a Storm Water Multi-Sector General Permit for Industrial Activities. At state level many DEP's require state DOT's to report significant non-compliance and future corrective action. Many

DOT's are working towards compliance by its highway maintenance facilities thereby seeking exemption from requiring a waste discharge license to operate.

A typical salt storage facility stores road salts, sand, sand-salt mixtures, and other solid chemicals used for de-icing, and salt-brine solutions used for pre-wetting and anti-icing applications. These materials are now required to be stored in closed enclosures to prevent discharge to the environment due to wind, moisture and handling.

### **Current Methods to Control Salt Runoff**

The Salt Institute (1997) and Transportation Association of Canada (1999) have developed comprehensive documents highlighting Best Management Practices (BMPs) for storage facilities. The machinery and equipment that are used to stockpile, mix, load/unload salt and handle salt brine are washed periodically to reduce the corrosion hazard. The accumulated solid and liquid waste generated while washing needs to be treated, and re-used or disposed. Many truck washing facilities owned by cities, townships and counties are now in the process of implementing best management practices in line with the regulatory requirements to prevent or minimize the discharge of salt runoff.

Best Management Practices (BMPs) include procedures, activities, and practices for the elimination, reduction or control of: dust, contaminated runoff, leaks, spillage, and drainage from material handling and storage areas. BMPs fall into two groups:

1. Non Structural BMPs - Control strategies for prevention
2. Structural BMPs - Minimize salts in storm water run-off

Bertram and Wolf 2001 concluded that operators of salt handling and storage sites are encouraged to implement and maintain site-specific structural controls and BMPs that provide protection for ground water, surface water, and air quality. Ineffective implementation and maintenance of controls by the industry and deicing salt end users may result in increased regulatory requirements for salt handling and storage. There is an abundance of literature, training publications, and audio/visual materials, etc. relative to salt storage structural controls and BMPs. A good starting point for a comprehensive review of such resources is the Salt Institute - Alexandria, VA.

### **Non Structural BMPs - Control strategies for prevention**

The most effective pollution control strategy is prevention. By improving salt storage operation/ maintenance techniques, uncontrolled salt runoff could be avoided. The following strategies may be utilized to reduce salt spillage during unloading and loading trucks and truck/equipment cleaning/washing operations: enclosed conveyors, roofed salt storage/maintenance facilities, prefabricated shelters, and proper housekeeping.

*Good Housekeeping*-Salt Institute President Richard L. Hannenman said: "... truly effective storage also includes consideration of employee and community safety, good housekeeping practices..." (Salt Institute, 1997). The proper handling of salt materials is

an economic consideration as well as environmental. Salt should be kept dry through proper storage to reduce waste. The handling area should be kept clean of spilled chemicals. Unnecessary handling can be reduced through proper planning of shipments. Loading and unloading operations should be shielded from wind and weather. Housekeeping and cleanup polices are very important and should be followed religiously. Any loss of control of the salt or housekeeping process can compromise the salt runoff prevention process.

### **Structural BMPs - Minimize salts in storm water run-off**

*Enclosed Conveyor*-Enclosed conveyors can be used to prevent salt spillage and reduce cleaning operations. They also increase efficiency and reduce cost of loading. If used it can lower salt loading time and minimize maintenance to zero. The key benefit of the enclosed conveyor is that the salt is completely aerated, and damage to the grillwork on truck tops from lumping and clumping of salt can be eliminated. The system ensures safety and environmental sensitivity through its totally enclosed design and construction, requires no clean up due to spillage, and resists corrosion. The conveyor method to load the salt domes boosts overall efficiency, reduces costs, decreases labor requirements, improves worker safety, and helps minimize environmental impact (Dwain 1998). The enclosed conveyors have been used on DOT yards and found to be effective in Schaumburg, Illinois; Nanuet, New York; Lewisboro, New York; and Holmdel, New Jersey (Dwain 1998).

*Roofed Salt Storage/Maintenance Facility*- A case study in Defiance County, Ohio involves a salt storage facility, which is located at the county's garage. The building is an 85' X 85' pole structure divided into sections. Salt and stone storage areas are located on 19' X 42' pads, salt/stone mixing area on 40' X 45' areas, equipment storage on 42' X 45' area, and inside loading area of 38' X 40'. The area used for loading allows maneuverability. The layout allows mixing with the front-end loader. The building has a 30' clearance, which allows the delivery and unloading of materials within the building. The mix area's 20' clearance permits the use of a front-end loader, fully raised, and dumping of a tandem axle truck, without concern of affecting the roof trusses. Handling the materials within an enclosed area eliminates also the concern for environmental effects. The described salt storage facility has been judged as one of North America's best and was honored with the Salt Institute's 1991 Excellence in Storage Award (Better Roads 1991).

*Prefabricated shelters* are a low-cost salt storage method. The City of Dover, New Hampshire uses a prefabricated and custom ordered-relocatable structure (Goodspeed et al., 1997). Prefabricated shelters have been used throughout the world. They can have a long life with low maintenance costs. The main components are: steel frame and PVC coated polyester fabric cover. The cover is tensioned over the frame and sealed to the foundation to provide a tight-fitting shell. It can be constructed and built in a very short time. The structure is large enough for salt trailers to dump inside the building. The cost in 1999 was \$21,160, which includes the building and all other construction costs, excluding labor (Goodspeed et al., 1997). The Public Works Department of Newmarket,

New Hampshire uses a fiber-reinforced plastic to reinforce concrete foundation walls and a hyperbolic shell to build a simple salt storage facility that is resistant to chloride corrosion (Goodspeed et al., 1997). The structure's roof is made of four hyperbolic paraboloids formed with corrugated steel sheets to cover the 61' diameter facility. It has a usable capacity of approximately 500 cu yd of salt with maximum head room of 32' and an entrance 18' wide by 13' high (Goodspeed et al., 1997).

### ***Treatment Techniques***

The following is a brief description of techniques to be applied to the site runoff.

***Evaporation Ponds***—Evaporation ponds can be an inexpensive method to separate the dissolved salt. The brine, collected at the facility, can be directed to an evaporation pond during active periods in the winter. At other times, the runoff from the facility can be directed to local receiving waters without any contamination. The collected brine can then be evaporated in the summer period. Utilizing topography and a cover of the evaporation pond, all of the brine could easily be evaporated in the non-winter months. Maintenance of the ponds results in the creation of salt/brine, and requires disposal unless the dried salt can be reused (Hayes et al., 1996).

***Constructed Wetlands***—Constructed wetlands can be used as an effective technique for salt runoff treatment for salt storage facilities. The ability of natural and constructed wetlands to purify water is well known. The addition of a fore bay or large detention pond or grease/sediment trap removes pollutants and sediments before they enter the wetland system. With the fore bay or detention pond added to the system, the low maintenance requirements are further reduced. Potential problems involved with the system include increased mosquito population, low pollutant removal in winter months, and regulatory problems (Hayes et al., 1996).

***Infiltration Trenches***—Infiltration Trenches can be used by the salt storage facilities with limited space available. When working as design, they provide a high particulate pollutant removal rate and a moderate soluble pollutant removal rate. The depth of ground water and soil type limits use of this option. The maximum drainage area for the system cannot exceed 5 acres and it should not be used in an area that experience long and cold winters because freezing of the soil prevents pollution removal. Regular maintenance is required to avoid clogging of the lower layers and the filter fabric, which would lead to the excavation of trench and its complete replacement. Inlet structures should also be inspected for clogging (Hayes et al., 1996).

***Advanced Treatment Techniques***—For salted water treatment the following techniques can be considered, however, the approach herein is to minimize their application due to associated high capital and maintenance costs: thermal distillation processes, multistage flash distillation (msf), multiple effect distillation (med), vapor compression distillation (vc), reverse osmosis (ro), and electro dialysis.

***Water Quality Pre-treatment Techniques***—While not directly addressing the primary focus of this project, the elimination of other pollutants will make addressing salt

pollution simpler.

There are numerous retrofit options to minimize salt run-off including: water quality swales, bioretention, pocket wetlands, storm water wetlands, extended dry detention basin, grade control structures with grass swales, water quality hazard spill basin, level spreader with forested/vegetated filter strip and grass swale with curb cut. The overall effort for BMP assessments requires a collaboration of engineering design, installation, field monitoring, synthesis of literature information, analysis of monitoring data, and assessment of BMP performance and effectiveness.

***Oil Grit Separators***- Oil grit separators can be used to remove hydrocarbons, rubbish, and sediment from runoff. They are easy to construct, save space because they are completely underground, and can effectively reduce the maintenance requirements when used with other measures. Maintenance, cleaning, and inspections are required to make them work properly.

### **Actions Taken by Other States**

The California Department of Transportation (CALTRANS) has developed storm water management practices for vehicle and equipment washing. Main instructions include:

1. Regular inspection of washing areas for wash pads, sediments, sump, oil separators etc. for cleaning
2. Training and instructions to employees and contractors.
3. Display of signs to indicate the usage instructions and discharge instructions
4. It is recommended to discharge all water discharge to recycling or a sump.
5. In case sumps are not available, it is suggested to provide straw bales or gravel bags.
6. Approved wash rack that is sloped to contain and drain wash water and constructed to prevent run-on and run-off.
7. Phosphate-free, biodegradable detergents should be used, when available.
8. Installation of oil water separators, rain sensors or canopies when required.

The *Indiana Department of Transportation* (In DOT) is currently investigating methods to evaluate the volumes and requirements for on-site collection of salt-laden wash water and runoff; and to evaluate pretreatment requirements with these latter streams, and to evaluate and establish suitable usage practices and protocols associated with these brine solutions (Alleman, 2002).

The *North Carolina Department of Transportation* (NC DOT) is developing similar systems. They are focusing on the equipment wash/maintenance facilities, and are planning to identify existing procedures and practices for equipment washing and also contacting other states to study practices followed by them. They are also planning to quantify pollutants of concern in equipment-wash wastewater by performing on site sample collection and identifying effective alternatives to equipment washing for NCDOT operations (Wu, 2003).

The *Municipality of Anchorage (MOA)* conducted a four-year study of snow disposal sites from 1998 through 2001, sponsored by the MOA Street Maintenance Department and the ADOT & PF, Central Region Maintenance and Operations, which revealed three important factors related to how pollutants are released during melting: initial source of hauled snow, melt processes of stored snowfall, and shape of storage areas and the snowfills (Wheaton and Rice, 2003). The study concluded that:

- Chloride can be controlled passively only through detention and dilution.
- Mobilization of metals and polynuclear aromatic hydrocarbons relates to chloride concentration, but a large fraction can be controlled with particulate capture.
- Particulate loading in melt water relates to the shape of the snow fill and the pad on which it is situated and can be controlled by manipulation of these elements.

As chloride is not readily treated by simple technologies, passive (non-chemical) treatment of chloride may be best addressed through:

- Control of street treatment processes (i.e., reducing use of salt).
- Dilution of early melt water discharges.
- Application of snow disposal site location criteria.

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## **BEST MANAGEMENT PRACTICES TO CONTROL SALT RUNOFF**

Based upon the results of the literature search and the team's expertise, the BMPs for controlling salt runoff was developed.

### **Non-Structural or Planning Level BMPs**

A primary source of salt entering the groundwater is salt spillage that is either released or washed from the maintenance yard. Care to minimize spillage and practices to clean up spilled salt can reduce costly losses and groundwater contamination.

### **Pollution Prevention Practices**

- Receiving of salt including conveyer
- Salt storage and salt management
- Chemical controls and handling of liquid chemicals
- Salt Spreader Calibration and Site Preparation
- Truck movement and loading
- Truck washing
- Truck storage and maintenance
- Housekeeping - sweeping, pavement maintenance, catch basin maintenance
- Training and instruction to employees and contractors using the area;
- Display of signs to indicate the usage instructions and discharge instructions;

### **Receiving of salt**

- Stockpiles frequently have portions that have become frozen. These frozen blocks need to be properly managed and should not be placed into spreaders. These blocks should be pushed into the corner of the storage facility and allowed to thaw and dry. Once they have thawed and dried, the material should be broken up and reintroduced to the pile. Where brine production is ongoing, blocks of pure salt can be put into the brine production tank.
- Deliveries of salt should be arranged such that material is placed within the covered storage facility as soon as possible upon delivery. Deliveries should be scheduled for periods of good weather.
- All deliveries should be covered when being transported to the maintenance yard.

### **Salt storage and salt management**

- Any roof leaks, tears, or damage should be temporarily repaired during winter to reduce the entrance of precipitation, with permanent repairs being completed prior to the next winter season. At no time should leaks be allowed to persist when materials are being stored inside.
- The floors should be inspected annually for cracks and repaired/resealed as required.

- Salt spilled outside of storage facilities or within or adjacent to maintenance yards should be collected and returned to the storage facility as soon as possible following the completion of the storm event.
- Excess salt and sand remaining in the spreader following a storm should be returned to the storage facility and deposited within or as close to the entrance of the salt storage facility as possible. Where materials are off-loaded outside of the storage facility, they must be placed into the storage facility as soon as possible
- Spilled materials should be swept up and returned to the pile. Some yards use mechanical sweepers.

### **Chemical controls and handling of liquid chemicals**

- The required storage capacity will depend on the security of supply, production/delivery times and rate of use.
- Storage capacity can be reduced by using an “on demand” system.
- Where supplier-owned storage containers are used, arrangements need to be made for the delivery of full containers and removal of empties during yard operations.
- Some liquids may require periodic circulation to prevent settlement of impurities, additives or product separation.

### **Salt Spreader Calibration and Site Preparation**

- Spreaders should be properly calibrated and periodically checked to ensure continued calibration. They should be recalibrated following any servicing of the salt delivery system.
- Some road authorities benchmark their beats to establish the amount of material that would be placed under specified application rates. At the end of a run, the total material placed can be compared to the benchmark to see if the projected amount was put down. If there is a discrepancy then the reasons should be investigated.

### **Truck movement and loading**

- Where practical to do so, spreaders should be loaded inside the storage structure. Where inside loading is not possible, other systems are needed to recover salt spills that occur during loading.
- When loading spreaders outside of the storage structure, care should be taken to minimize spillage of salt onto the loading pad. Overloaded spreaders are prone to spilling salt during operations. Therefore, spreaders should not be loaded beyond their capacity and, where feasible, should be covered with tarps when loaded with salt or sand.
- When loading spreaders a maximum height above the grate should be approximately 30 cm to avoid lumps falling off into traffic and spillage. A rake down rack is often used.

### **Vehicle Washing**

- Vehicles should be washed at a location where the wash water can be properly diluted, disposed, or treated. Prior to washing, the spreaders should be swept to

- remove as much of the residual solids as possible and thereby minimize the amount of dissolved salt and solids in the wash water.
- Vehicles should be washed with medium-duty (2000-2600 psi) pressure washers capable of removing residual salt and grit.
  - Where possible, vehicles should be washed indoors rather than outdoors to contain the wash water. Where only outdoor washing is possible, it should be done where all wash water can be contained and directed through positive drainage to a water management system. It is preferable to direct wash water to a storage facility where it can be reused for brine production or sent for disposal. Careful consideration must be given to the ultimate receiver of the wash water.
  - All vehicle wash water should be directed through an oil/grit separator.
  - Wash water should not be directed to a storm water drain.
  - Phosphate-free, biodegradable detergents should be used, when available.

### **Truck storage and maintenance**

- Trucks should be maintained on site, unless there is an approved facility
- Trucks should be cleaned before garaging
- Floor of the truck garaging location should be regularly inspected to note oil and grease leaks and if found the trucks should be repaired to prevent future leaks.

### **Housekeeping**

- Spilled materials should be swept up and returned to the pile. Some yards use mechanical sweepers.
- Regular inspection of washing areas for wash pads, sediments, sump, oil separators, etc. for cleaning.

### **Training**

Training should focus on ensuring that those handling salt at the yard minimize the potential to waste salt and impact the environment. Prior to each winter all staff that are handling winter sand and deicing chemicals should receive training. The training program should focus on the following learning goals with respect to maintenance yards:

- Understand that all salt and sand/salt blends should be covered to minimize salt loss.
- Understand that salt spillage is wasteful and harmful to the environment.
- Understand the salt-handling activities that result in wasteful releases of salt to the environment.
- Understand how these salt-handling activities should be carried out to prevent the wasteful release of salt to the environment.
- Understand the maintenance yard salt cleanup procedures that must be followed.
- Understand that timely yard maintenance and repairs are necessary to control salt loss.
- Understand the importance of proper record keeping and how to complete the required documentation on yard maintenance and salt use.

Training should be carried out through the following methods:

- Pre-winter briefings;

- Observation and corrective action;
- Informal briefings during the season.

### **Display of signs**

Signs should be displayed throughout the yard to remind employees of major non-structural BMPs.

### **Structural BMPs**

In addition to the non-structural BMPs, the following structural BMPs are recommended for yard upgrades or new yards:

- Where possible, a salt barn should be constructed for salt storage and all loading/unloading operations.
- Loading/unloading operations should be conducted under cover at sites where there are sensitive receptors.
- Salt storage structures without closable doors should not be oriented facing prevailing winds.
- Proper leveling of asphalt to carry drainage away from the salt storage building and prevent ponding and ultimate deterioration of surface.
- Curbs should be provided to contain and direct all runoff to storm drains.
- Where possible, facilities should be sited away from sites having or close to groundwater wells that are a source of drinking water.
- Internal wash bays with pressure washers (medium-duty ~2000-2600 psi) and oil/grit separators should be provided for vehicle washing.
- Where practical, secondary containment of liquid chemicals should be provided through double walled tanks or containment dykes. Typically, containment capacity is 110-125% of the capacity of the largest tank.
- Crash protection should be provided to prevent vehicles from impacting the production and storage facilities.
- Designers must take into account the desired fill time for spreaders when selecting pump and line sizes. Pumps and lines that are too small will prolong the time it takes to refill onboard tanks.
- Production and storage tanks must be designed with a clean-out or flushing capability to remove settled impurities.
- Salt-tolerant trees and shrubs should be planted around the site.

### **SITE VISITS**

Upon completion of the literature search and review of same, the site visitations were initiated in the summer of 2005 and continued through the remainder of the year. All team members visited two sites for orientation purposes and to ensure relative uniformity for the remaining site visits.

The NJIT project team visited all 84 maintenance yards. The facility information form was filled out after each site visit. A typical completed form follows:

Basic Data Sheet

<b>Facility Name</b>	Folsom Landscape Yard
<b>City, County</b>	Folsom, Atlantic County
<b>Location</b>	Rt 54, south of Rt 73
<b>Facility Contact</b>	Debbie Needham 609-561-8121
<b>Area Coordinator</b>	Pete Welsh 609-352-8942
<b>Vehicle Maintenance</b>	Not performed on site. Performed at Buena facility
<b>Storage Sheds</b>	One large storage shed with a feeding conveyor. Salt is delivered outside while the conveyor distributes the salt it inside. The shed has a roof drain above the canopy.
<b>Calcium chloride</b>	There are two outside tanks that are used when the temperature is below 27 degrees Fahrenheit.
<b>Vehicle fueling</b>	A fueling station with an aboveground tank is on the site.
<b>Stormwater Drainage</b>	The site has new asphalt. Two stormwater grates direct stormwater runoff around the truck unloading, storage shed and calcium chloride tanks to drain to nearby detention pond. Another drainage location for the roadway area flows into the woods in the direction of Rt 54.
<b>Sanitary Sewers</b>	There is a septic system on site. A manhole was located in the pond area, but its function was unknown.
<b>Water Supply</b>	There is well water containing lead at the facility.
<b>Receptors</b>	Detention pond. And woods.
<b>Neighboring Lands &amp; Facilities</b>	Pinelands surround the area. Mulching operations nearby. Adjacent to Folsom landscape yard is a ballfield (Little League); area surrounded by undeveloped wooded area, and perimeter is screened. Site fronts on Route 54 Southbound and topographically drains from the rear of the site into the site (therefore little concerns of off-site operations).
<b>Community Complains</b>	None reported.
<b>Remarks</b>	Have partnering agreements for servicing neighboring municipalities with salt storage.

A compendium of all 84 facility information forms may be found in Appendix 1.

An environmental review of the 84 sites and their environs was also performed. A typical site form is included below and a compendium may also be found in Appendix 1.

**Salt Site Environmental Information Form**

**Facility Name:** Maintenance Yard

Address: Rt. 54

City/Zip: Folsom

**Environmental Information**

Receiving water course for runoff from the facility:

Name: Great Egg Harbor River

Classification of watercourse: ON

Availability of USGS water quality data:

NJDEP quality designation:

Watershed name: Great Egg Harbor

Watershed Management Area number: 15

Special environmental features: None

Does the stream flow to a lake/reservoir? No

Does the lake/reservoir flush? -

Quality designation of the lake/reservoir: -

Approximate volume of the lake/reservoir: -

Quality problems of the lake/reservoir? -

Is the facility site situated in an aquifer recharge area? Kirkwood – Cohansey Aquifer – 0 in.

Water Quality Data (USGS)

See the following website for further information.

[http://water.usgs.gov/pubs/wdr/2004/wdr-nj-04-3/pdf/wdrnj04\\_3.pdf](http://water.usgs.gov/pubs/wdr/2004/wdr-nj-04-3/pdf/wdrnj04_3.pdf)

The water quality classifications are defined by the USGS as follows:

- "C1" means Category One waters. "Category one waters" means those waters designated in the tables in N.J.A.C. 7:9B-1.15(c) through (h), for purposes of implementing the antidegradation policies set forth at N.J.A.C. 7:9B-1.5(d), for protection from measurable changes in water quality characteristics because of their clarity, color, scenic setting, other characteristics of aesthetic value, exceptional ecological significance, exceptional recreational significance, exceptional water supply significance, or exceptional fisheries resource(s). These waters may include, but are not limited to:

1. Waters originating wholly within Federal, interstate, State, county, or municipal parks, forests, fish and wildlife lands, and other special holdings that have not been designated as FW1 at N.J.A.C. 7:9B-1.15(h) Table 6;
2. Waters classified at N.J.A.C. 7:9B-1.15(c) through (g) as FW2 trout production waters and their tributaries;
3. Surface waters classified in this subchapter as FW2 trout maintenance or FW2 non-trout that are upstream of waters classified in this subchapter as FW2 trout production;
4. Shellfish waters of exceptional resource value; or
5. Other waters and their tributaries that flow through, or border, Federal, State, county or municipal parks, forests, fish and wildlife lands, and other special holdings.

- "C2" means Category Two waters. "Category two waters" means those waters not designated as Outstanding National Resource Waters or Category One at N.J.A.C. 7:9B-1.15 for purposes of implementing the antidegradation policies set forth at N.J.A.C. 7:9B-1.5(d).

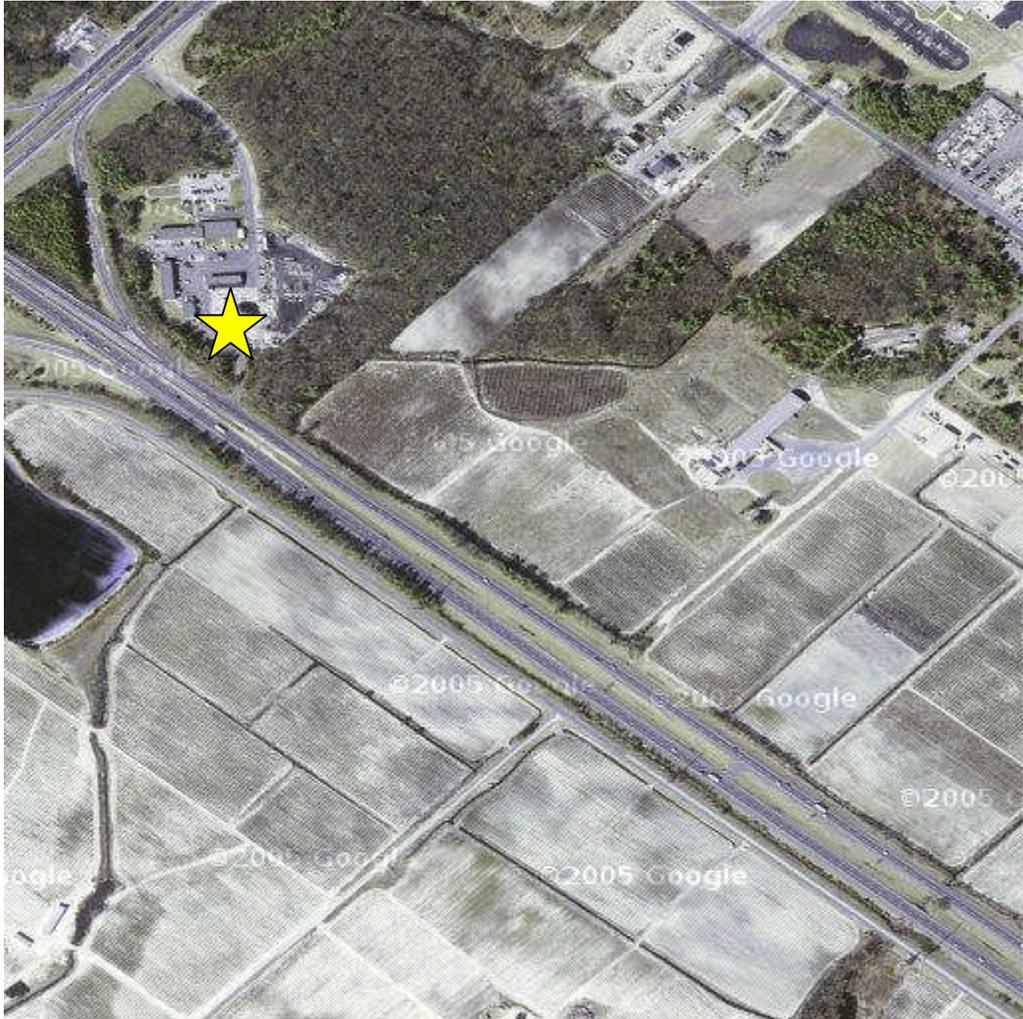
- ON or "Outstanding National Resource Waters" are high quality waters that constitute and outstanding national resource (for example, waters of National/State Parks and

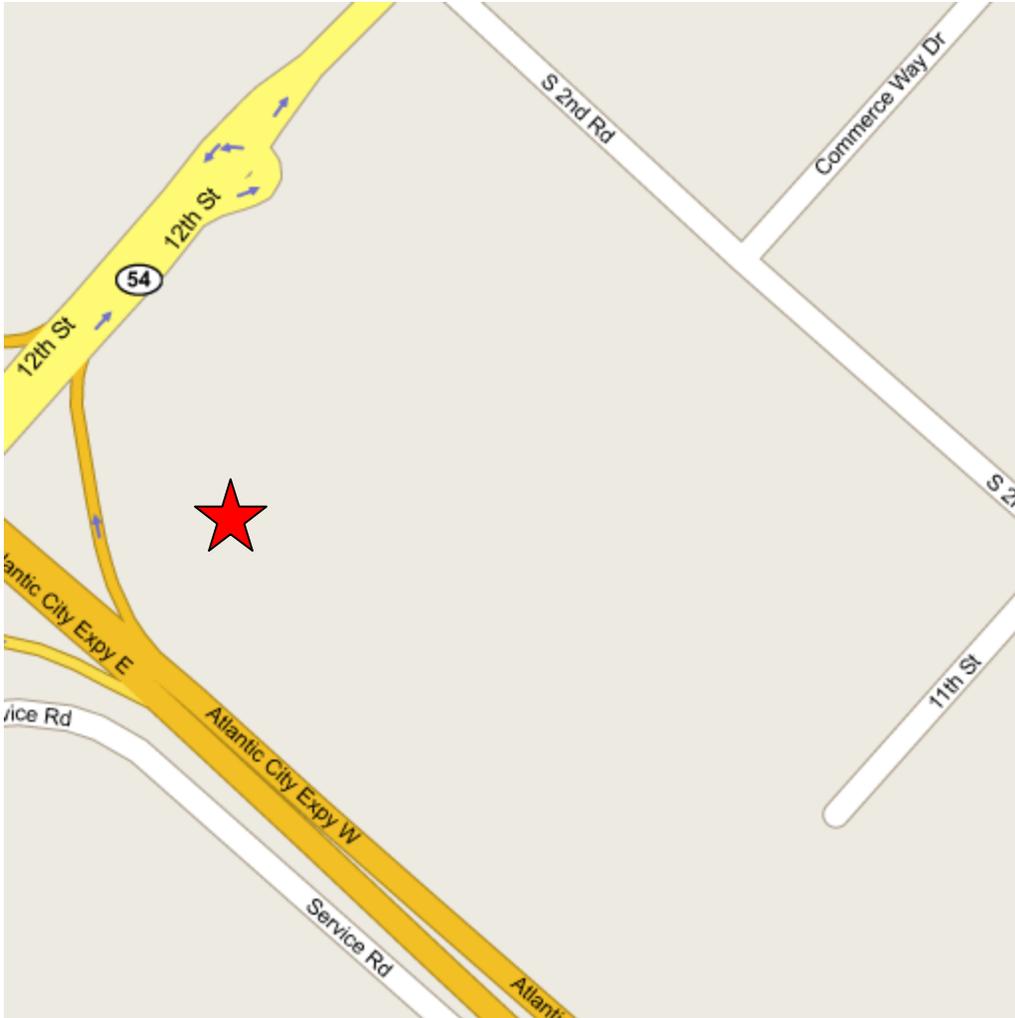
Wildlife Refuges and waters of exceptional recreational or ecological significances) as designated in N.J.A.C. 7:9B-1.15(i).

- "FW1" means those fresh waters, as designated in N.J.A.C. 7:9B-1.15(h) Table 6, and as defined at N.J.A.C. 7:9B-1.4.
- "FW2-TP" means FW2 trout production.
- "FW2-TM" means FW2 trout maintenance.
- "FW2-NT" means FW2 non trout.
- "PL" means Pinelands Waters.
- "SE1" means saline estuarine waters whose designated uses are listed in N.J.A.C. 7:9B-1.12(d).
- "SE2" means saline estuarine waters whose designated uses are listed in N.J.A.C. 7:9B-1.12(e).
- "SE3" means saline estuarine waters whose designated uses are listed in N.J.A.C. 7:9B-1.12(f).
- "SC" means the general surface water classification applied to saline coastal waters.
- FW2-NT/SE1 (or a similar designation that combines two classifications) means a waterway in which there may be a salt water/fresh water interface. The exact point of demarcation between the fresh and saline waters must be determined by salinity measurements and is that point where the salinity reaches 3.5 parts per thousand at mean high tide. The stream is classified as FW2-NT in the fresh portions (salinity less than or equal to 3.5 parts per thousand at mean high tide) and SE1 in the saline portions.
- "TP" or "Trout production waters" means waters designated at N.J.A.C. 7:9B-1.15(b) through (g) for use by trout for spawning or nursery purposes during their first summer.
- "TM" or "Trout maintenance waters" means waters designated at N.J.A.C. 7:9B-1.15(b) through (g) for the support of trout throughout the year.
- "NT" or "Nontrout waters" means fresh waters that have not been designated in N.J.A.C. 7:9B-1.15(b) through (h) as trout production or trout maintenance. These waters are generally not suitable for trout because of their physical, chemical, or biological characteristics, but are suitable for a wide variety of other fish species.

In addition, an aerial photo of the site area and a street map is also included in Appendix 1.

A typical site follows:





Lastly, photographs of the salt facility sites were taken which depict the various aspects of each site. Where appropriate, photographs were also taken of adjacent properties.

The combination of site information, local environmental conditions, quality and identification of receiving waters, location maps, aerial photos and photos of each site provides a source of reference information to the NJDOT which may be found on the attached DVD. The DVD also contains reference documents of interest.

### **Synopsis of Database**

The overall findings resulting from the site visits are summarized as follows:

- The majority of the sites are well maintained with pavement in good condition. Toms River, Wall Township, Clifton, East Rutherford, Franklin Lakes, High Point, Manunka Cunk, Mountainside and Hazlet have pavement that is in marginal or poor condition and should be improved as budget becomes available.

- Most of the sites utilize domars for salt storage; some utilize sheds which are in various conditions and a few have salt barns. Clifton, North Bergen, High Point, Lafayette, Mountainside, Sussex, Cape May, Pennsauken, Hazlet, Bridgeport, Buena, Deptford, Edgewater Park, Mc Kee City, Manunka Cunk and Yellow Frame are serviced by sheds or open block containers that should be upgraded as budget allows.
- The site managers were found to be professional, cooperative and cognizant of their responsibilities.
- Many of the sites have sealed discharge outlets in compliance with NJDEP mandates.
- There were virtually no complaints registered to site managers by adjacent property owners.
- There are several sites without potable water and sewer service. These are tabulated in Table 1, p.29.

## **TRUCK WASHING PLAN**

### **Introduction**

At the February 2005 meeting with the NJDEP cited earlier, they indicated that Burlington County was coordinating with municipalities to share the costs of building and maintaining commercial truck washing facilities. Further, they stated if these facilities could be utilized by the NJDOT, this could be instrumental in bringing the yards into compliance by 2009.

Since there are only a few truck washing facilities operating in New Jersey, the project team was asked to investigate the cost and site requirements associated with construction and operation of truck washing facilities. To this end a study was initiated by the project team in the summer of 2005. The project team researched the companies that specialized in commercial truck washing facilities. One of the companies contacted who was active in the New Jersey area is Rieskamp Equipment Company, Inc.

In 2005, a site visit to an operational facility, located near Harrisburg, PA, was conducted with a Reiskamp representative who provided information on cost and siting requirements. A second visit to a truck washing facility built by another manufacturer was made by the team to a site in Hartford, Connecticut. A new facility has recently been constructed in Lakewood, NJ.

This information on the state-of-the-art of truck washing was presented to the three regional directors of NJDOT and other Department personnel as noted below in the minutes of 5/18/2006.

***NJDOT – TRUCK WASHING MEETING MINUTES – 5/18/2006***

A plan for implementation of zero discharge from truck washing facilities for the NJDOT maintenance yards must be in place to satisfy NJDEP requirements by 2009. The plan would include details on the implementation of the program as well as budgets for construction as well as operation.

Discussion was held on the use of commercial grade truck washing facilities as an approach for compliance. Area requirements of 100' by 40' for a specially designed building plus adequate room for truck turning radii requirements would be needed. The approximate cost (not including land) for a facility is \$700,000. Issues to be resolved include responsibilities for maintenance and operation as well as coordination with other potential users, e.g., counties and municipalities. This was not considered by NJDOT to be the best way to meet the DEP standards.

There are several other possibilities for developing a plan to satisfy NJDEP requirements that was offered at the meeting. These approaches include:

- Install wash bays at yards with sanitary sewer connections. The bays should include oil/grease separators and sediment traps (some sewer authorities may also require sand filter polishing) as a pretreatment device prior to discharge into a sanitary sewer system.
- At maintenance yards without sanitary connections, trucks to be washed would travel to a nearby yard with wash bays and sanitary connections.
- The question of regionalization of truck wash facilities to maximize the number of sites with wash bays will be studied for efficiency and cost effectiveness. More sophisticated facilities may be more economical and efficient when the plan focuses on regional facilities.
- A one-way travel time of 30 to 40 minutes to a wash facility is considered by the NJDOT representatives to be acceptable at a maximum.
- The use of county, municipal or commercial truck washing facilities as may be developed in the State may be used where convenient or needed to augment the above alternatives.

The maintenance yard wash bay facilities should include the following:

- The facility should allow for trucks to be elevated in the bay to allow for the thorough washing of the truck body.
- Washing facilities may incorporate semi permanent structures to do the washing. This may include sprayers in the ground to wash the underside of the trucks as well as siting nozzles to wash specific parts of the trucks.

The plan, when ultimately developed, should be treated as a line item in the NJDOT budget. The plan should also identify the timeframe for implementation.

The various alternatives noted above will be analyzed by NJIT. The results will be presented to the NJDOT.

In order to conduct the analysis the following will be performed as noted below:

NJIT will set up meeting(s) for NJDOT personnel to see a commercial truck washing facility in Lakewood in operation.

DOT will provide NJIT their current 5-year plan for expanding sanitary sewer service to their maintenance yards.

DOT will provide NJIT with a listing of all yards that currently have sanitary sewer service.

DOT will provide NJIT a listing of all current sites with operational wash bay facilities.

DOT will provide plans and the cost associated with the recently constructed wash bay at the Township maintenance yard. NJIT plans to visit the Wall facility to inspect same.

Attendees at the meeting were:

Bill Carter	NJDOT-region south
Mike DeAngelo	NJDOT-facilities
Bob Dresnack	NJIT-CEE department
Angelo Gatto	NJDOT-region south
Gene Golub	NJIT-CEE department
Walter Konon	NJIT-CEE department
Bob Lane	NJDOT-enviro. center ops
Greg Monkan	NJDOT-region center ops
Mike Moran	NJDOT-region center ops
Mark Renner	NJDOT-facilities
Jeff Spicka	NJDOT-region north

A table containing all NJDOT sites without sanitary sewer service may be found in Table 1 as follows:

NORTH REGION - 3 Sites with Well Water, 12 Sites with Septic Systems									
Facility Name	County	Well Water	Septic System	Salt Storage (Tons)	Calcium Chloride Storage (Gal.)	Water Chloride Levels (ppm)	Sample Date		
Branchville	Sussex	Y	Y	3000	11200	27	07-08-05		
Columbia	Warren	Y	Y	2500	12000	27	07-07-05		
Hackettstown	Warren	N	Y	550	11600	-	-		
High Point	Sussex	N*	Y	750	5600	-	-		
Knowlton Rest Area	Warren	Y	Y	-	-	470	07-07-05		
Lafayette	Sussex	Y	Y	500	5600	110	07-08-05		
Mt. Arlington Regional	Morris	Y	N	-	-	27	07-07-05		
Riverdale	Morris	N	Y	2200	11200	-	-		
Rockaway	Morris	N	Y	3000	14100	-	-		
Springfield / Summit	Union	N	Y	3400	11200	-	-		
Stanhope	Sussex	Y	Y	-	-	550	07-08-05		
Sussex	Sussex	N	Y	500	5600	-	-		
Washington Port Coldon	Warren	N	Y	3500	11200	-	-		
Yellow Frame	Warren	Y	Y	400	11200	140	07-07-05		
CENTRAL REGION - 5 Sites with Well Water, 5 Sites with Septic Systems									
Facility Name	County	Well Water	Septic System	Salt Storage (Tons)	Calcium Chloride Storage (Gal.)	Water Chloride Levels (ppm)	Sample Date		
Bloomsbury	Hunterdon	Y	Y	3000	10800	120	07-05-05		
College Farm	Middlesex	N	Y	2400	10800	-	-		
Ocean	Monmouth	Y	Y	8400	10800	6	07-06-05		
Sand Hill	Middlesex	Y	Y	2400	10800	2	07-05-05		
West Arnewell	Hunterdon	Y	Y	2400	10800	160	07-05-05		
SOUTH REGION - 12 Sites with Well Water, 10 Sites with Septic Systems									
Facility Name	County	Well Water	Septic System	Salt Storage (Tons)	Calcium Chloride Storage (Gal.)	Water Chloride Levels (ppm)	Sample Date		
Bridgeport	Gloucester	Y	Y	550	4500	190	07-08-05		
Cumberland	Cumberland	Y	Y	2800	9000	3	07-21-05		
Deptford	Gloucester	Y	N	600	5400	1.5	07-08-05		
Elmer	Salem	Y	Y	500	5400	3.6	07-21-05		
Folsom	Atlantic	Y	Y	8500	11200	18	07-06-05		
Four Mile	Burlington	Y	Y	450	5400	5.7	07-19-05		
Mays Landing	Atlantic	Y	Y	1900	10800	4.7	07-06-05		
McKee City	Atlantic	Y	Y	100	5400	16	07-06-05		
Middle Township	Cape May	Y	Y	350	10800	13	07-07-05		
Mt. Laurel	Burlington	Y	N	3500	10500	1.1	07-11-05		
Red Lion (Southampton)	Burlington	Y	Y	3500	10800	1.8	07-11-05		
Petersburg	Cape May	Y	Y	300	5400	6.1	07-07-05		

\* Water line extends to DOT facility from a well that is located on the adjacent property of the Department of Corrections.

Table 1 NJDOT Sites Without Sanitary Sewer Service

Subsequent to this meeting a site visit was conducted to the Wall Facility to inspect an existing “wash bay facility”. It consisted of outlets for connection of hoses for the wash and connection to a sanitary sewer for disposal of spent water.

The following data was requested from the Regional Directors:

1. Number & placement of truck wash facilities.
2. Frequency of use of truck wash facilities.

3. Estimated travel times from various NJDOT sites to truck wash sites.
4. Current use of BMPs at salt and maintenance sites.
5. Current conformance with NJDEP '04 regulations.
6. Progress of conformance with '09 implementation of regulations.
7. Specific problems in meeting compliance.
8. Details of plans to meet compliance
9. Cost estimate to meet compliance.
10. Schedule of activities to meet compliance.
11. Do three regional directors use same policies for conformance?
12. Which sites have problems associated with salt yards?
13. Which sites do the regional directors consider model sites.

### **Truck Washing Options for the NJDOT**

In partial response to the meeting held on 5/18/06, the NJIT team presented a series of possible approaches to a truck washing program starting from a least cost approach to more sophisticated and expensive solutions. The intent is to allow all maintenance yards a method to insure that their salt trucks could be washed either on-site or at neighboring yards or non-DOT facilities equipped to provide support.

#### **(1) Outdoor Pad with a Power Washer**

The pad is rectangular in shape with drains surrounding the pad as shown in Figure 2 – Open Air Truck Wash Station. The washing and rinsing is done with a power washer. The water is heated and detergent is added for the wash cycle. Washing and rinsing can only be done when the temperature is above freezing to avoid coating the trucks with ice. This approach can only be used at an NJDOT site that has sanitary sewer service to dispose of the wash and rinse water and the salt and other materials on the truck.

The runoff from the wash process is collected in the drains surrounding the pad. A grit settlement chamber will be located under the drains. The water will then be conveyed by pipe to an oil and grease separator located in an existing, nearby building. The effluent will then be conveyed to the sanitary sewer system for ultimate disposal.

#### **(2) Heated Outdoor Pad with a Power Washer, Radiant Heaters & Air Blowers for Drying**

The process would be the same as (1) with added features that will allow operation in temperatures below freezing.

The radiant heaters will warm the truck being washed as well as the personnel working on the trucks. The heaters would be mounted on poles around the pad. The air blowers will be used to remove residual water from the trucks after washing.

#### **(3) Power Washer in a Heated Building**

The process would be similar to (1) except done in a heated building. This could be done in a bay in an existing building with simple retrofitting. The space in the bay would have to be sufficient to perform the washing process.

Of the 84 DOT sites, there are approximately 28 that do not have connections to sanitary sewers and cannot be served by the approaches, 1, 2, and 3 cited above. Several solutions are possible.

As per typical sewer authority requirements, the bay needs to be physically separated, e.g. knee wall, from other bays. Lastly, hazardous materials cannot be stored in the bay.

**(4) Truck Washing Done at other DOT Sites**

Sites without sanitary service can send their trucks to other DOT sites that may be in reasonable proximity. NJIT will provide a report on those sites that can reasonably travel to another location.

**(5) Truck Washing Done at other non-DOT Sites**

Public or private organizations may or have developed truck washing facilities that they might allow the DOT to use their facilities for a fee. The NJDEP rules that impact the DOT will also impact many other organizations, public and private. They may well develop facilities and might welcome the financial support of a paying customer.

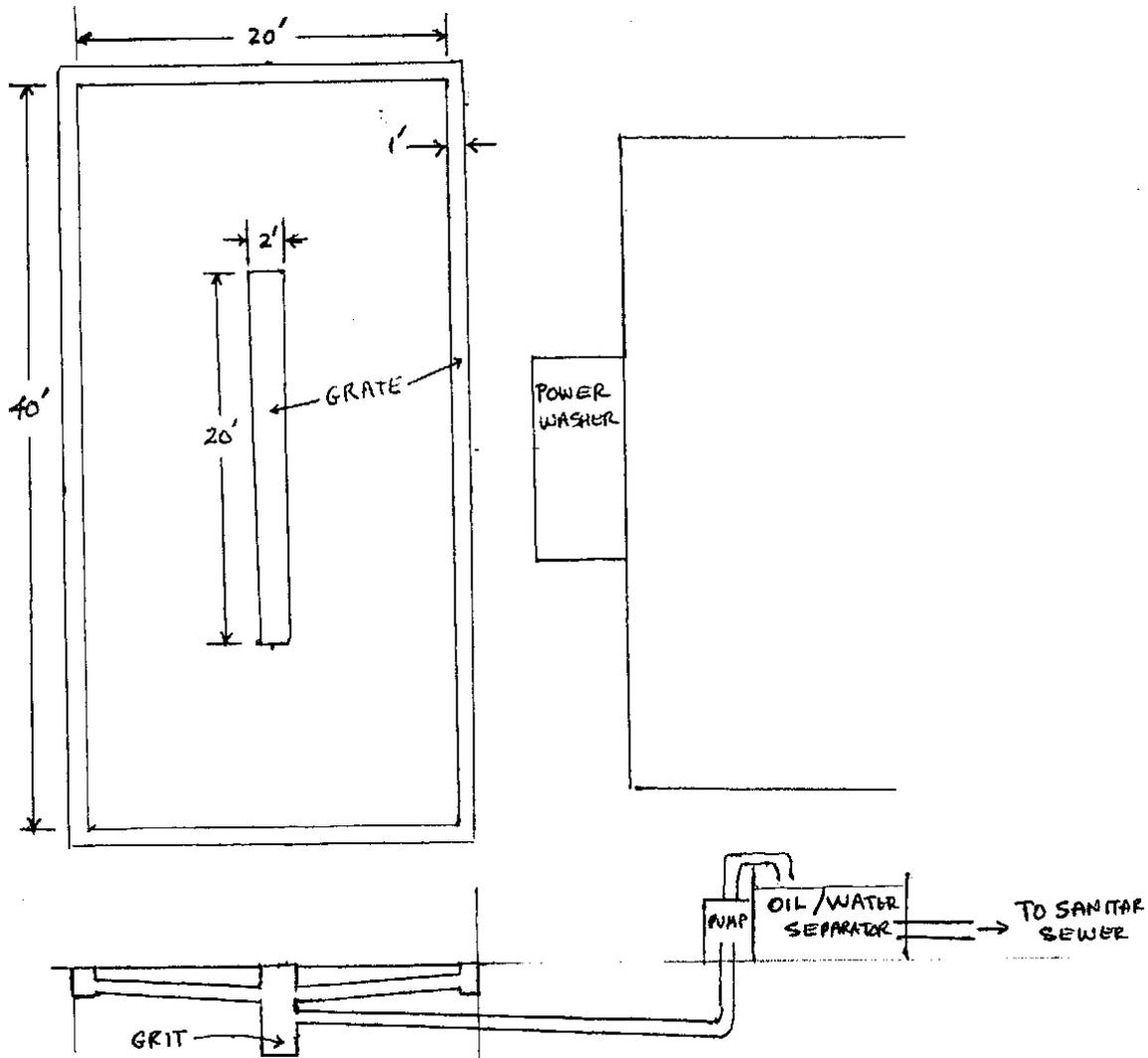


Figure 2 – Open Air Truck Wash Station

**(6) Develop a Closed-recycled System**

For those sites that cannot be served by 1-5, cited above, a recycled, closed system could potentially be used. The wash water would be recycled and fresh rinse water would be added after each new truck. Grit and dirt would be separated out. The recycled water, in part, would be removed from the system as fresh rinse water is added. The purged grit and recycled water would be held in tanks, picked up periodically and brought to a secure disposal location. This is an expensive approach.

The six options noted above were presented at a quarterly meeting with the NJDOT in September 2006. It was suggested that a meeting be set up with the three regional directors to introduce the plan.

A concept plan will be developed by NJIT for the DOT's approval. The first step of the plan would be to develop one or two sites to see how the system works. After the trial period, budget will direct the speed with which the program is expanded.

Revised Minutes of Meeting Related to Truck Washing  
November 20, 2006 at Office of Regional  
Director William Carter, Regional Operator South

Gene Golub (NJIT), Bob Dresnack (NJIT), and Bob Lane (NJDOT) met with William Carter and staff. Gene presented the draft concept outlined herein of possible truck washing scenarios for the 84 sites maintained by the NJDOT both for sites with and without sanitary sewer connections. The draft concept was the same as presented by NJIT on October 27<sup>th</sup> to the northern and central regional operations attendees.

Bob Lane indicated that if no detergents are used for truck rinsing, there are no problems with compliance with NJDEP stormwater regulations. He pointed out, however, that oil and grease and solids removal from trucks would necessitate the use of detergents which would require truck washing subject to NJDEP regulations by 2009.

Bill Carter indicated that in terms of priorities (subject to budget constraints, he would prefer to see the following:

1. All sites in the southern region have a truck washing facility housed indoors in a new heated structure dedicated solely for washing purposes.
2. If option number one is not financially feasible, then the following regional sites would be selected with the same infrastructure as noted above:

Petersburg (if not, Middle Township site)  
Buena  
Cherry Hill  
Deepwater

Should sites such as Middle Township, McKee City and Mays Landing ultimately be provided with a sanitary sewer system, the above regional sites maybe revised? NJIT indicated that it would preliminarily cost out the new truck washing facilities suggested by Bill Carter, as well as the approximate space requirements needed to site the structures and route the trucks safely through the truck wash facility. NJIT will also develop a plan for sites without the proposed car wash facilities to optimally wash their trucks at the closest proposed regional facilities. Bill Carter suggested a 40 minute travel time or less for truck wash purposes to be utilized in the analysis. He estimated an approximate time of 40 minutes for trucks to travel between the Middle Township and Petersburg yards, and between Petersburg and the Pomona Yards (as well as others in close proximity to Pomona).

In discussion with Jeff Spika, North Regional Director, he suggested, 12/19/06, Hanover, Newark, Sussex, Lodi and Netcong as possible salt truck washing sites in the North. The

response was based upon a limited budget allowing for only five sites in the region to be chosen to service the region.

Lisa Cavanaugh, on 1/19/07, in response to a similar request for selecting five sites to accommodate the central region's truck washing needs responded, "... I have had discussions with Bernard James, Regional Director, and Michael Moran, Regional Maintenance Engineer concerning our preference for the truck washing facilities. As previously expressed by Mike Moran, at earlier meetings concerning this matter, Central Region's first preference would be to contract out the truck washing at other than DOT locations. As personnel and maintenance of these areas would most likely not be supplemented and budgeted for.

If we have no other options, we would prefer to have truck wash facilities installed at the following Central Region locations, which would be used by the yards in the area; Bridgewater, Hamilton, Metuchen, Freehold and Lakewood. I understand that this is still in the study phase and you are going to cost out the options proposed. If the Department opts to have these facilities installed in our yards, will strongly recommend they solely be used by DOT forces and NOT offered to other agencies to use."

### **TRUCK WASHING PLANS AND ASSOCIATED COSTS**

The NJIT team has developed cost estimates for the six truck washing approaches presented to the three regional directors as cited above. The costs for the six processes as well as two other scenarios follow:

#### **(1) Outdoor Pad with a Power Washer**

The estimated cost of the pad and washer is \$50,000. This approach would also require some oil/water separation prior disposal to a sanitary system. The added cost of the oil/water separator is estimated as \$25,000. The total estimated cost is \$75,000. The dedicated area required for this approach is approximately 25' x 40'.

#### **(2) Heated Outdoor Pad with a Power Washer, Radiant Heaters & Air Blowers for Drying**

The estimated cost of an outdoor heated pad added to scenario (1) totals \$130,000. The dedicated area required is 30' by 50'.

#### **(3) Power Washer in a Heated Building**

The estimated cost of a new heated building (20' x 40') with grit collection piping, air blower, and an oil/water separator is \$220,000. It may also be possible to retrofit a bay in an existing facility with an additional cost of \$150,000. This, however, will restrict the use of that bay and may not be feasible.

Of the 84 DOT sites, there are approximately 28 that do not have connections to sanitary sewers and cannot be served by the approaches, 1, 2 and 3 cited above. Several solutions are possible.

#### **(4) Truck Washing Done at other DOT Sites**

Sites without sanitary service can send their trucks to other DOT sites that may be in reasonable proximity (defined as 30-40 minutes one way travel time) that do have sanitary sewer service. There is an implied cost associated with the travel time, fuel costs and the wear and tear on the vehicles.

**(5) Truck Washing Done at other non-DOT Sites**

Public or private organizations may or have developed truck washing facilities that they might allow the DOT to use their facilities for a fee. There is an implied cost associated with the travel time, fuel costs and the wear and tear on the vehicles as well as a fee for the washing service.

**(6) Develop a Closed-recycled System**

For those sites that cannot be served by 1-3 cited above, a recycled, closed system could potentially be used. The estimated cost of a water recycling system is approximately \$60,000 in addition to the base cost of the system, e.g. outdoor pad - \$135,000.

**(7) Automatic Truck/Vehicle Wash System**

Install a commercially available automatic truck wash in a heated building (40' x 80'). Pre-soak, high pressure wash, rinse, air strip, heated entrance and exit pads. The estimated cost is approximately \$800,000, plus \$5 for chemicals per wash. Dedicated area required 40' x 140' plus truck waiting and approach areas.

**ECONOMIC ANALYSIS RELATED TO TRUCK WASHING TO ACHIEVE COMPLIANCE IN 2009 WITH NJDEP REGULATIONS**

As previously noted, there is a significant number (i.e., approximately 28) of yards that do not have connections to sanitary sewer systems. Most of these sites (i.e. 23) are located in other southern sections (i.e. 10) of the State or the northern section of the State (primarily in Sussex and Warren Counties) where the density of population is generally too sparse to warrant the construction of sanitary sewer systems. The DOT does have a plan for providing sanitary sewers to some additional sites in their five year plan which may affect strategies as noted herein.

**Truck Washing Performed at Other DOT Sites**

The various truck washing scenarios previously noted in this report all involve capital costs. However, as previously noted a strategy involving continuous movement of NJDOT yard fleets from one site to another also involves costs as indicated herein.

**Cost of Movement of Fleets for Truck Washing Purposes**

In order to estimate the cost to the NJDOT in terms of labor and operating costs associated with fleet movement to other sites for truck washing purposes, the following reasoning is utilized to estimate a cost per truck wash. Obviously, the NJDOT can modify the numbers shown based upon data which they believe are more representative of the facts.

- Each maintenance yard has a fleet of 7 trucks (found to be the case for most yards).

- The average distance from site to site is 15 miles one way.
- The average time to traverse from site to site is 30 – 45 minutes one way.
- An estimated wait time at the truck washing site to have the truck washed is 15 minutes.
- The average annual salary plus benefits of the NJDOT yard truck drivers is estimated at \$75,000 per year.
- An estimated truck life of 80,000 miles and a cost per truck of \$120,000 gives a capital cost of \$1.50/mile

### **Cost per Truck Wash**

Based on the above assumed figures, the approximate cost to wash one truck, one time is as follows:

(1) **Labor Cost:** \$75,000/year

Assume work load is 40 hrs./week x 50 weeks = 2,000 hrs/yr. (i.e. 2 weeks vacation).  
Therefore, hourly cost is  $\frac{\$75,000}{2,000} = \mathbf{\$37.50 \text{ per hour}}$

Thus, one trip equals \$37.50/hr. x 1.75 hrs. = \$65.63/trip

(2) **Truck Depreciation:** \$1.50/mile x 30 miles = \$45/trip

(3) Fuel costs @ 30 miles/6 mi/gal x \$3.00/gal = \$15/trip

Therefore, the approximate cost per car wash per trip = \$125

If a fleet of 7 trucks were washed, on average, once every two weeks, plus six additional times during the winter during snow events, a total of 32 truck washings per truck per year would be required. It is anticipated that the NJDEP may require more periodic washing throughout the year (than the current estimate which is based on current operations). Using the above-noted assumptions for distance, time, and depreciation costs, the annual cost to wash a fleet from one site traveling to a neighboring site would be as follows:

$\$125/\text{truck}/\text{wash} \times 7 \text{ trucks} \times 32 \text{ washes}/\text{year} = \$28,000/\text{yr per site}.$

As such, without any additional infrastructure utilized by the NJDOT for truck washing purposes at non-sewered locations, the annual cost, based on an assumed truck washing program of once every two weeks involves a considerable annual operational expenditure. It should also be noted that the computations represent an average trip of 15 miles. Many sites are more than 15 miles from a sewered site and may not be a feasible solution.

### **Outdoor Pads with Power Washes**

The facilities in the northern part of the state will probably need heated pads to prevent freezing of the wash water. Approximately 50% of the sites will need the heated pads. Computations for the capital costs to the NJDOT for placing (un)heated outdoor pads at the 80 operational sites follows:

14 unsewered sites @ \$135,000/site =	\$1,890,000
14 unsewered sites @ \$190,000/site =	\$2,660,000
26 sewerred sites @ \$75,000/site =	\$1,950,000
26 sewerred sites @ \$130,000/site =	<u>\$3,380,000</u>
Total Cost =	\$9,880,000

**Power Washing in a Heated Building**

The addition of a heated building will increase the costs of the outdoor pads to \$220,000 for a sewerred site. For unsewerred sites, an additional \$60,000 per site is required. The heated pad costs above are no longer part of the cost since the building is heated.

28 unsewerred sites @ \$280,000/site =	\$7,840,000
52 sewerred sites @ \$220,000/site =	<u>\$11,440,000</u>
Total Cost =	\$19,280,000

**Retrofitting an NJDOT Garage Bay to a Wash Bay**

The estimated cost to retrofit a bay in an existing building – grit collection piping, walls, heat, air blower, oil/water separator is \$150,000. Existing bays, however, may not be wide enough or have the required area to properly accommodate the needed equipment.

For comparison purposes, the capital cost for retrofitting a garage bay at all 80 sites would be:

Sewerred sites	52 sites X \$150,000 =	\$7,800,000
Unsewerred sites	28sites X \$210,000 =	<u>\$5,810,000</u>
Total capital cost		\$13,610,000

**Truck Washing Done at non-DOT Sites**

The approximate cost to have a truck washed at a commercial facility is approximately \$40 per wash. To this must be added the cost of \$125 per wash trip for a 15 mile travel as shown above. This cost can be prorated for different travel distances to the wash facility. For comparison purposes, assuming the average trip cost as \$165, the cost for the entire fleet would be approximately; \$165 X 7 trucks X 80sites X 32 washes per year = \$2,957,000 per year.

**Summary**

The calculations of the four truck washing scenarios are understood to be estimates. They do however indicate the capital improvements are less costly than sending trucks over significant distances to regional centers.

The NJDOT may consider a budget request to complete the total capital improvements and based upon State budget meet the NJDEP requirements as the budget allows.

### **STEPS NEEDED TO UPGRADE EXISTING FACILITIES TO MEET BMPs STANDARDS**

Lastly, the NJIT Team provides below a general assessment of steps needed to upgrade all of the salt yards to BMP standards.

- Where economically feasible, bring sanitary sewers to unsewered sites.
- A regular program of maintaining high quality pavement should be initiated.
- Those sites with salt sheds should be upgraded to state-of-the-art Barns.
- When budget is available, develop a program to replace domars with Barns.
- Increase the use of conveyors to load salt into the domars.

### **SITE SELECTION FOR NEW FACILITIES**

As part of the project NJIT was asked to review four salt sites that were subject to pollution problems. A review of same developed key issues to be considered in the siting of new facilities include the following:

- Accessibility to municipal water and sanitary sewer systems.
- Neighboring sites should no be served by shallow well supplies.
- Neighboring sites should not be environmentally sensitive, e.g. drains to lake or valuable wetlands.
- Neighboring sites should not be residential in nature.
- Site topography should be such that all site drainage can be captured within the confines of the site.
- Other constraints as set forth in BMPs section of the report.

## **SUMMARY AND CONCLUSIONS**

### **Change of Scope for the Project**

Early into the contract, at a meeting with NJDEP's stormwater management representatives and the project manager, it was established that the best approach for the NJDOT's 84 maintenance yards to achieve compliance in 2009 would be to develop and demonstrate best management practices on each site by sealing off all stormwater discharges via storm drains, and to minimize salt loss from the site due to truck washing operations and loading of salt due to truck deliveries to the salt storage domes (domars). This approach would eliminate the need to secure permits, which in the opinion of NJDEP, could prove to be costly and time consuming for the NJDOT.

At the above meeting with the NJDEP, they further suggested that developing a program of truck washing by the NJDOT at centralized sites equipped with sanitary sewers and grease/oil separators and with truck washing technology in lieu of washing trucks outdoors with no wastewater collection capabilities would be the best approach to handling concerns of salt loss due to truck washing activities.

As a result of the above discussions with the NJDEP and conclusions drawn therefrom, the NJDOT, at a subsequent quarterly meeting agreed to a revised scope of services to best attempt to comply with the 2004 stormwater regulations by 2009. Two outcomes were changed. The first was for NJIT to visit all 84 maintenance yards versus the 8 to 10 sites originally contemplated. The second was to conduct a study of the state-of-the art in truck washing technology and related costs, and its potential application to NJDOT's yard maintenance facilities. The study included visitations to a number of existing truck washing facilities in the tri state area. In addition, NJIT was asked to review and render opinions regarding problems that existed at a few NJDOT maintenance yard sites where alleged salt runoff from the NJDOT sites were impacting on neighboring properties.

### **General Conclusions Related to the 84 Site Visits**

A review of the data compiled from the 84 yard maintenance sites visited indicated that most of the sites were in good condition, and were constructed within the past 10 to 15 years. Those sites where compliance with the stormwater regulations could currently be difficult to achieve exhibited one or more of the following conditions: no central water and wastewater systems to tie into the respective NJDOT sites; outdated salt storage sheds constructed of wood in lieu of domars or barns; the site surface either being poorly paved (i.e., numerous cracks), or not paved over the entire site; and neighboring properties with residential uses and/or other sensitive receptors serviced by individual groundwater wells or commercial uses such as landscape nurseries which could be potentially vulnerable to salt runoff from the NJDOT sites. The sites that require upgrading or maintenance are cited earlier in the report under the section, Synopsis of the Database and should be attended to as budget becomes available.

### **Investigation of Possible Truck Washing Scenarios**

In order to minimize salt runoff due to truck washing operations, the following studies were conducted:

- Securing a list from the NJDOT of those maintenance yards without sanitary sewers. Of the 84 sites, 28 were found to be without sanitary sewers. Most of these sites were located in the southern and northern regions of the state where sparser population densities exist.
- Meeting with the Southern, Central and Northern regional coordinators to enlist their aid in selecting five (5) sites in each region where central truck washing facilities could be located to minimize initial capital cost to the NJDOT, and to minimize travel time from the remaining maintenance sites to these facilities. All

remaining sites, whether sewerred or not would transport their vehicles to the proposed truck wash facilities. Developing cost estimates to provide truck washing options for the 84 sites as follows:

### **Options for Sites With Sanitary Sewer Service**

- Outdoor Pad with a power washer on each site (primarily for sites in Southern and Central New Jersey).
- Heated outdoor pad with a power washer, radiant heaters and air blowers for drying purposes on each site (primarily for sites in Northern New Jersey).
- Power Washer in a heated building on each site.

### **Options for Sites Without Sanitary Sewer Service**

- Truck washing done at other DOT sites, and related cost of movement of fleets for truck washing purposes.
- Truck washing done at other non-DOT sites, and costs to move fleets and to pay wash costs to independent owners of facilities.
- Development of closed recycled systems and storage of wastewater for collection and disposal by private contractors.

### **Costs associated with the Various Options**

The findings indicate that the least initial capital cost would be to provide truck washing capabilities at the 15 above-mentioned sites suggested by the three regional coordinators, and have the remaining yards move their fleets to these centers for truck washing purposes. This, however, will shorten the usable life of the trucks.

However, because of the high annual labor and depreciation costs associated with moving the fleets to the 15 centralized truck washing facilities on a regular basis, it would be more cost effective to aggressively pursue a program of providing truck washing facilities at each yard as quickly as funding could be provided. It is recognized, however, that because of the current budget deficits that exist at the State level, the probability of major funding provided to the NJDOT for truck washing enhancement will be difficult. As such, the more modest program of developing regional truck wash centers seems more plausible at this writing.

### **Upgrades for Salt Yards**

The NJDOT is currently embarked on a five year program to provide sanitary sewer service to as many salt yards without same currently where it is economically feasible to do so. This policy will be helpful in minimizing impacts of leachate from improperly operating septic tanks onto neighboring properties to the respective sites, and would allow for more sites to be used as truck washing centers, thus minimizing fleet travel. Sites without salt storage domes or barns should be upgraded with barns such that salt deliveries can be conducted within the structure. For sites with domes (which is the

mass majority of sites), deliveries should be conveyed where possible from the salt delivery trucks to the domes. Where this is not possible, salt spills during the loading of domes and loading of trucks during salting operations should be controlled using best management practices noted in this report. Lastly, salt dome openings should be covered at all other times, particularly where the opening faces the south and/or west (direction of prevailing winds).

### **Siting Future Yards**

In order to minimize impacts associated with future sites used for yard maintenance purposes, the following criteria should be considered:

- Design the sites with barns for salt storage purposes wherein all salt deliveries and truck loading and unloading of salt during winter operations can be conducted in a closed environment.
- The sites and its surrounding land uses should be serviced by central water and sewage systems.
- The neighboring land uses should be in an industrial zoned area where feasible. One should not site a yard in close proximity to residential zones and/or other sensitive receptors.
- The site should be designed with a wash bay specifically dedicated for truck washing purposes.
- The site topography should be such that any accidental spills can be readily directed to the sanitary sewer system.

If the above criteria are considered in future site selections, it will virtually mitigate against future problems associated with neighboring properties.

### **Sites with Environmental Sensitivity**

The overall findings resulting from the site visits with regard to environmental sensitivity are as follows:

- The majority of the sites are well maintained with pavement in good condition. Toms River, Wall Township, Clifton, East Rutherford, Franklin Lakes, High Point, Manunka Cunk, Mountainside and Hazlet have pavement that is in marginal or poor condition and should be improved to minimize ground water contamination.
- Most of the sites utilize domars for salt storage; some utilize sheds which are in various conditions and a few have salt barns. Clifton, North Bergen, High Point, Lafayette, Mountainside, Sussex, Cape May, Pennsauken, Hazlet, Bridgeport,

Buena, Deptford, Edgewater Park, Mc Kee City, Manunka Cunk and Yellow Frame are serviced by sheds or open block containers that should be upgraded as budget allows to minimize ground water contamination at the sites.

- Many of the sites have sealed discharge outlets in compliance with NJDEP mandates which minimize potential ground water contamination.
- There are several sites without potable water and sewer service. These are tabulated in Table 1, p.29. The Department has a program to provide sanitary sewer service at sites where feasibility exists. This program will reduce the potential for groundwater contamination at the above mentioned sites.